Sector Metering

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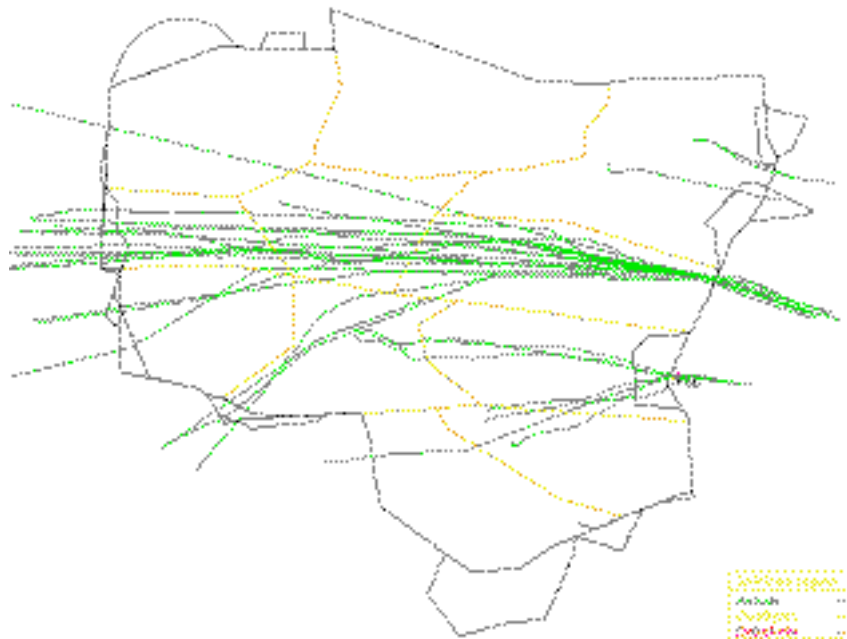
DAG Conference

May 23, 2000

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- Current Sectorization, ATC Preferred Routes and Traffic Management Practices Cause Inefficiencies

- The Inefficiencies are Caused by the Imposition of Constraints that can be More Restrictive than Necessary to Keep Airplanes Separated

JFK Arrivals through
Cleveland Center
High Altitude Airspace

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Outline

- Air Traffic Management Objectives

- Case Study

- Role of Sector Metering

- C-Flow Tool Demo

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- The Basic Objectives of Air Traffic Management are:

    1. Ensure Airplanes Don't Hit Each Other

    2. Ensure Airplanes Stay Out of Restricted Airspace

- In any ATM Structure that Involves Human Monitoring of Flights, a Further Objective is:

    3. Ensure that Human Workload Remains at a Safe Level so that the First Two Objectives can be Met

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Air Traffic Management (cont.)

- To Achieve These Objectives, Two Separate Elements of Air Traffic Management Exist:

  – Air Traffic Control

  – Traffic Flow Management

- Air Traffic Control

  – The Responsibility Distributed to an Individual Controller or Controller Team to Meet Objectives 1 & 2 Within a Sector

- Traffic Flow Management

  – The Responsibility to Manage Workload to Meet Objective 3 Within an Area, Center or NAS-Wide

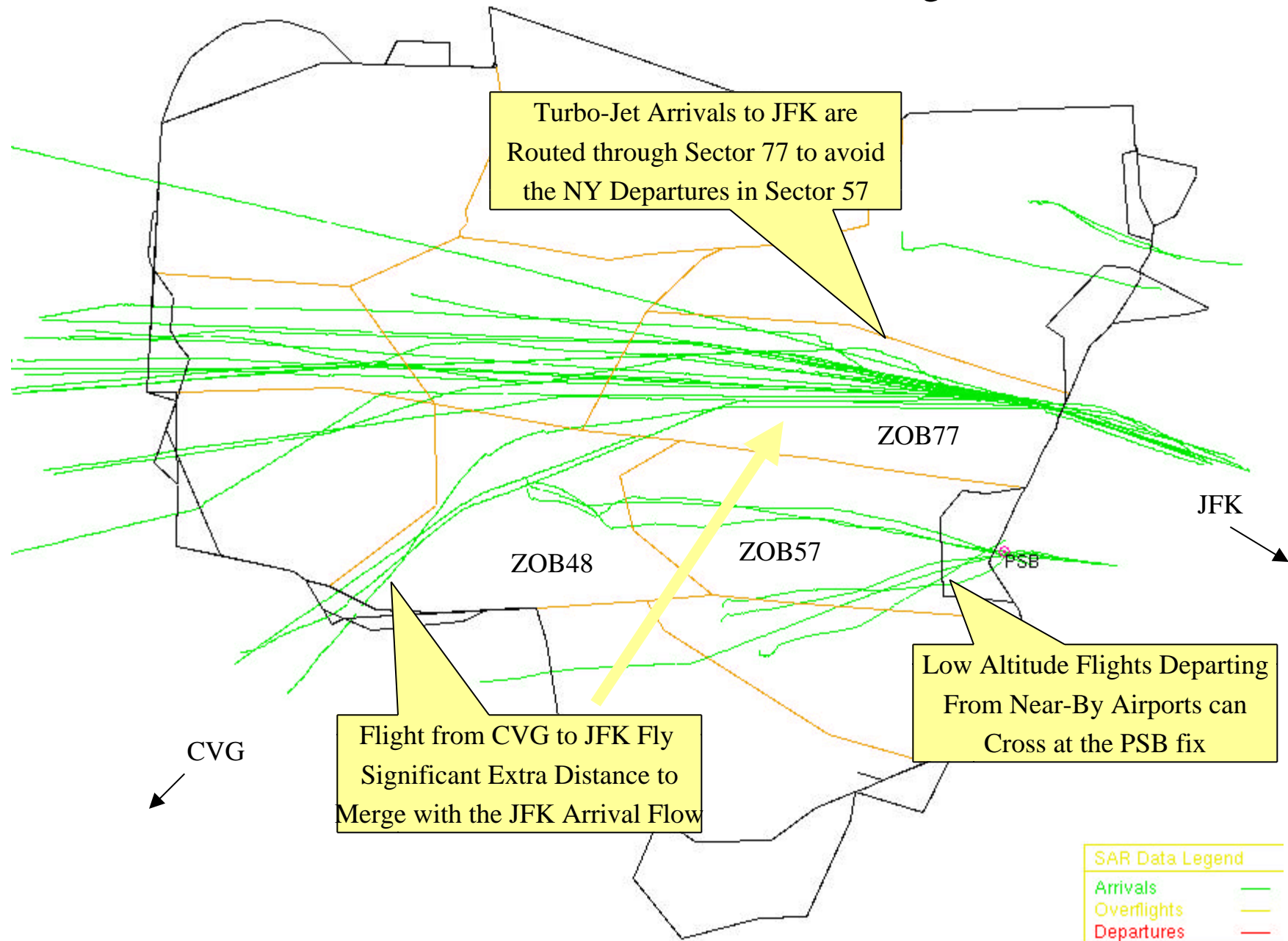**METRON**

Traffic Flow Management

- TFM is Conducted Using Numerous Procedures:

  - ATC Preferred Routes

  - Miles-in-Trail

  - Minutes-in-Trail

  - Ground Delay Programs

  - Ground Stops

  - Time-Based Metering

- ATC Preferred Routes

  - Due to the Complexity of Traffic Flows, Organization must be Enforced to Reduce Workload and Improve Situational Awareness

- Miles-in-Trail Restrictions

  - Flight must be Organized into a Single Stream to which Miles-in-Trail Restrictions are Applied

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- Current TFM Procedures Induce some Inefficiencies:

    – Flights Must Form a Single Stream for Miles-in-Trail Restrictions

    – Miles-in-Trail Restrictions are Not Inherently Efficient due to:

        • Quantization Effects, and

        • Dynamic Demand Patterns

    – No Tools are Available to Evaluate the Impact of and Need for Miles-in-Trail Restrictions, Making Planning Inaccurate

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Actual Flown Routes of JFK Arrivals through ZOB

Turbo-Jet Arrivals to JFK are Routed through Sector 77 to avoid the NY Departures in Sector 57

ZOB77

JFK

ZOB48

ZOB57

PSB

Low Altitude Flights Departing From Near-By Airports can Cross at the PSB fix

CVG

Flight from CVG to JFK Fly Significant Extra Distance to Merge with the JFK Arrival Flow

SAR Data Legend
Arrivals
Overflights
Departures

- Sector Metering is a New Traffic Flow Management Procedure

  - Scheduled Sector Boundary Times are Assigned to Each Flight

  - Controllers Meet the Scheduled Times at the Sector Exit Point Using Speed Control, Vectoring and other Clearances

- Some Current Inefficiencies Caused by TFM can be Removed Through Sector Metering

  - It is Not Necessary to Form a Single Stream, Thus Deviations from User Preferred Routes are Not Required

  - Variable Time Intervals can be Used Between Flights, Thus No Quanitization Effect Exists

  - Tools can be Used to Plan Sector Metering Times Efficiently

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Sector Metering Problem Statement

- Sector Metering Addresses the Following Problem:

- Given the Set of Flights in the NAS,

  - $i = 1$ to N, represents Flights

  - $j = 1$ to M, represents Sectors

  - let ETA (i, j) be the Estimated Time of Entry of Flight i into Sector j

  - let $S(j,t)$ be the Count of Flights in Sectors

  - let $D(j,t)$ be the Airborne Delay

  - let MaxS (j) be the Maximum Count of Flights in Sectors

  - let MaxD (j) be the Maximum Airborne Delay Capacity in Sectors

  Assign STA (i,j), the Scheduled Time of Entry of Flight i into Sector j, such that:

  $S(j,t) <=$ MaxS (j) for all t

  $D(j,t) <=$ MaxD (j) for all t

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PSB

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